Summary of Joint COPAG/ ExoPAG Meeting

April 26, 2011
Space Telescope Science Institute

Presented by Jim Kasting

Recommendations

1. First, and most importantly, *cooperation* between ExoPAG and COPAG is essential if we wish to have the 2020 Decadal Survey select a large UVOIR telescope. Continued joint meetings, perhaps in the form of joint sessions at the Winter AAS meetings, would be a good way to pursue this goal.

Recommendations (cont.)

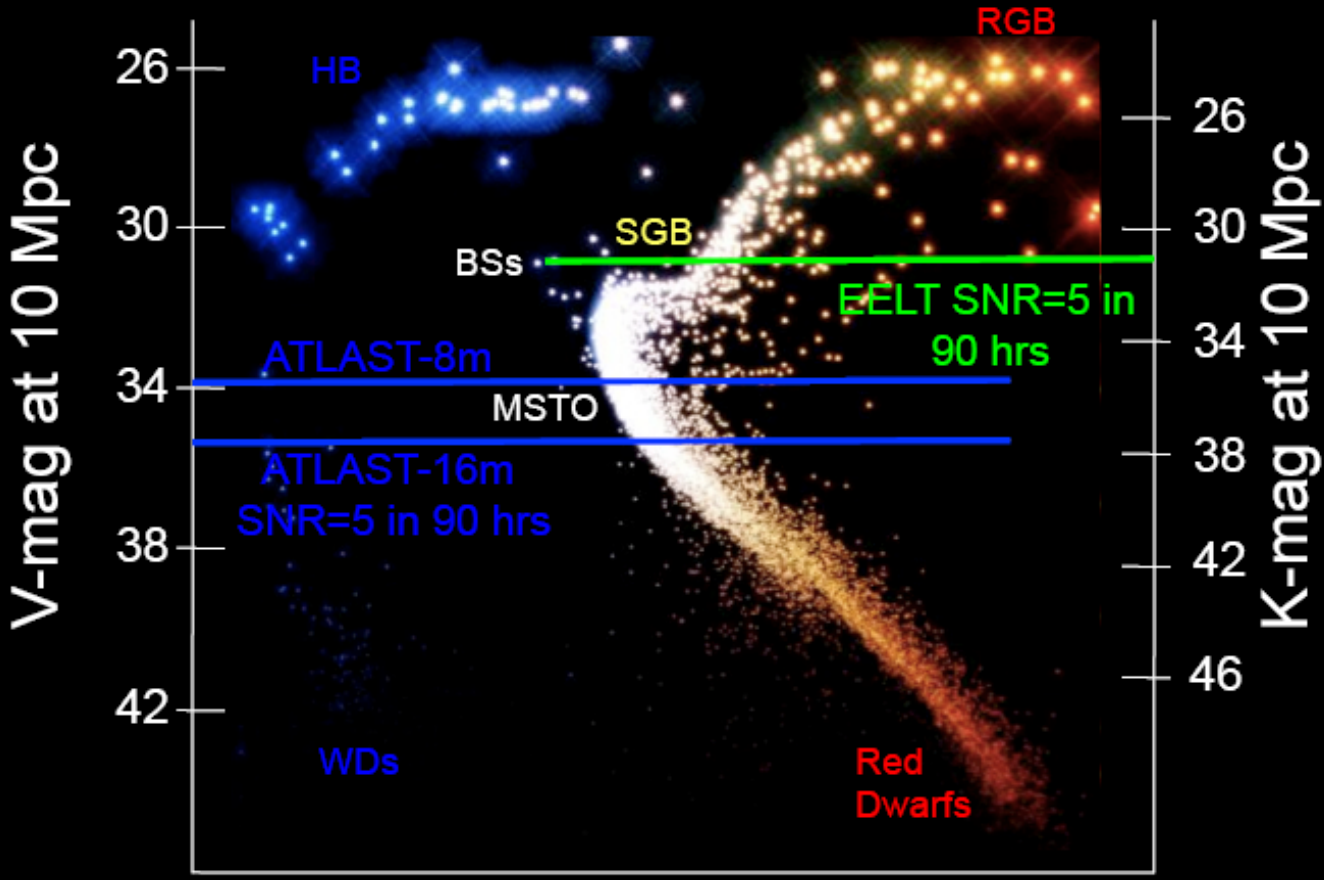
2. Both groups should pursue the study of two different types of representative missions:
   1. A 4-m aperture monolithic telescope with an internal coronagraph of some sort. The coronagraph must be capable of achieving a contrast ratio of 10-10 or better in order to find exoEarths. It would need to operate at an inner working angle of ~2 λ/D in order to satisfy the exoplanet science requirements.
      - A possible alternative to this architecture, which could be studied at the same time, would be an 8×3.5 m monolithic telescope, similar to that studied in the 2005-06 TPF-C study. This telescope could achieve the same angular resolution while operating at 4 λ/D. As Charley Noecker emphasized in his presentation, the requirements on wavefront stability are greatly relaxed if one operates at a larger inner working angle, as would happen in this design.
   2. An 8-m aperture segmented telescope that relies on an external occulter to achieve the high contrast needed to find an exoEarth.
      - Note that these two architectures do not have to be mutually exclusive. One could imagine an 8-m segmented mirror that included at least one 4-m monolithic segment. One could potentially include a somewhat lower resolution internal coronagraph attached to this segment and simultaneously fly an occulter to get the extremely high contrast (<10-10) needed to find exoEarths.

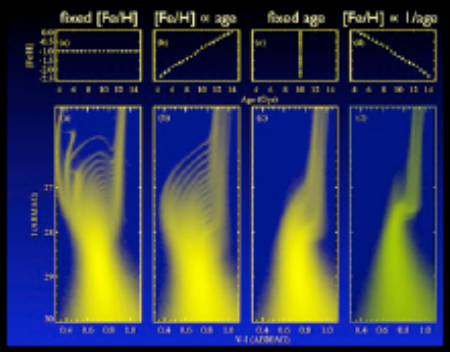
- Different segments of the COPAG community have different goals
  - The folks from STScI are really interested in 8-m telescopes $\Rightarrow$

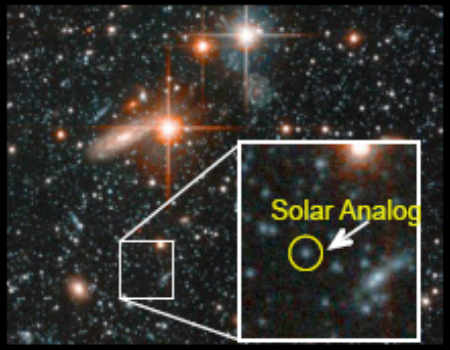
Cosmic Origins Science Overview

Marc Postman
Space Telescope Science Institute
April 26, 2011

An 8-m+ class ST could detect the Main Sequence Turn-Off in Galaxies up to 10 Mpc Away



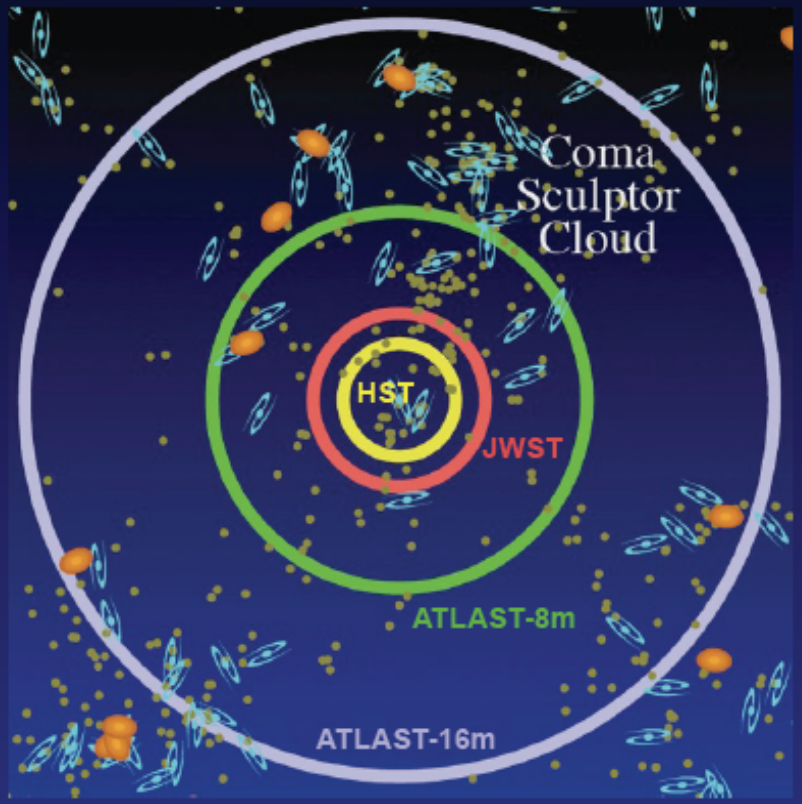




CMD image: J. Anderson
Flux scale: K. Olsen et al. 2009

What is the Star Formation History of Galaxies as f (M,T,env) and is the IMF Universal?

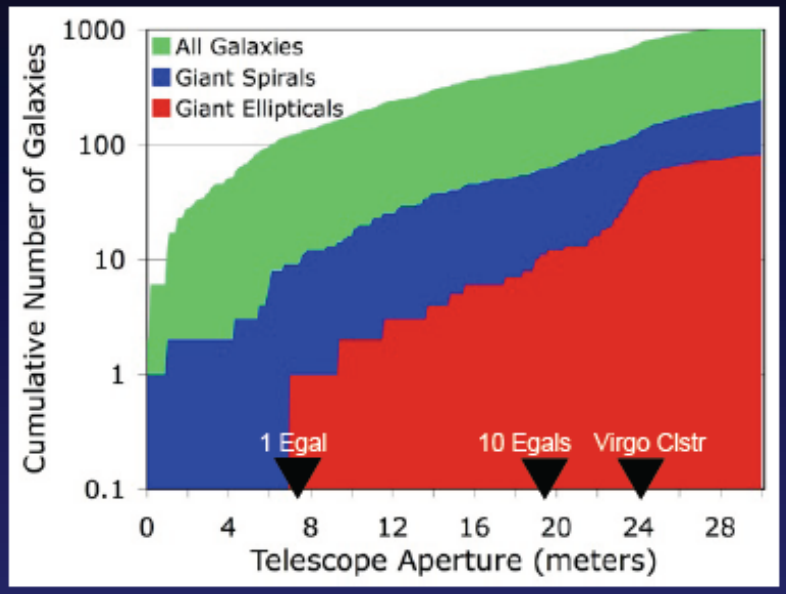
Galaxies within 12 Mpc of Our Galaxy



= Large Elliptical Galaxy

= Large Spiral Galaxy

= Dwarf Galaxy



An 8-m (or larger) space telescope will detect individual solar type stars in the main sequence in nearby Elliptical galaxies.

This will yield a major breakthrough in our understanding of how galaxies assemble their stars. No other planned facility will have this capability.

- By contrast, the UV science community would be perfectly happy with a 4-m telescope $\Rightarrow$

UVOIR Technology Needs
(Cosmic Origins Program Analysis Group)

Ken Sembach
(Space Telescope Science Institute)
April 26, 2011

On behalf of the COPAG Executive Committee,
Chair: Chris Martin

COPAG Tasks

- **Determine technology focus areas for a large UVOIR mission in the next decade**
  - Possible areas of investment
    - Detectors
    - Optical coatings
    - Gratings
    - Multiplexing elements / IFUs
    - Wavefront sensing and control
    - Lightweight mirrors
  - This activity was divided into two tasks – one to identify the needs for a standalone UVOIR Cosmic Origins mission, and one to identify the needs for a joint UVOIR Cosmic Origins / Exoplanet mission
- **Determine technology focus areas for future Far-IR instruments**
  - Not part of today's discussion

Selected Astro2010 White Papers

- Several key Astro2010 white paper references:
  - *Technology Investments to Meet the Needs of Astronomy at Ultraviolet Wavelengths in the 21st Century* (technology white paper #54 – Sembach et al.)
  - THEIA: Telescope for Habitable Exoplanets and Interstellar/ Intergalactic Astronomy (RFI #132 – Kasdin et al.)
  - Advanced Technology Large Aperture Space Telescope - ATLAST (RFI #13 – Postman et al.)

> Key advances could be made with a telescope with a 4-meter-diameter aperture with large field of view and fitted with high-efficiency UV and optical cameras/spectrographs operating at shorter wavelengths than HST. This is a compelling vision that requires further technology development. The committee highly recommends a modest program of technology development to begin mission trade-off studies, in particular those contrasting coronagraph and star-shade approaches, and to invest in essential technologies such as detectors, coatings, and optics, to prepare for a mission to be considered by the 2020 decadal survey. A notional budget of $40 million for the decade is recommended.

Recommendations (cont.)

3. As a corollary to recommendation 2, both groups need to define a set of science goals that could be achieved with such observatories. The goals will clearly be somewhat different for the 8-m telescope than for the 4-m. These science goals need to be defined as early as possible, preferably in time to provide guidance for the money devoted to technology in NASA's next budget proposal (so, by September, 2011).
4. We may want to set up some joint telecons within the next few months to help define these science goals and to keep the two PAGs in touch with each other.